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Occupational Safety and Health Administration

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TRICHLOROETHYLENE

Proposed Occupational Exposure Standard

DEPARTMENT OF LABOR

Occupational Safety and Health Administration

[29 CFR Part 1910]

[Docket No. H–048]

OCCUPATIONAL EXPOSURE TO TRICHLOROETHYLENE

Notice of Proposed Rulemaking

Pursuant to sections 6(b) and 8(c) of the Occupational Safety and Health Act of 1970 ("the Act") (84 Stat. 1593, 1599; 29 U.S.C. 655, 657), and Title 29, Code of Federal Regulations ("CFR") Part 1911, it is proposed to amend Part 1910 of 29 CFR by deleting the present standard for trichloroethylene ("TCE") contained in § 1910.1000, Table Z–2 (formerly § 1910.93, Table G–2), and by adding a new occupational safety and health standard for exposure to TCE as § 1910.1027. This standard would apply to all employments in all industries covered by the Act, including "general industry," construction, and maritime. In addition, pursuant to section 4(b)(2) of the Act (84 Stat. 1592, 29 U.S.C. 653), if the new standard, when promulgated, is determined to be more effective than corresponding standards now applicable to the maritime and construction industries contained in Subpart B of Part 1910, Parts 1915, 1916, 1917, 1918, and 1926 of 29 CFR, the new TCE standard will supersede the corresponding maritime and construction standards for exposure to TCE. Appropriate conforming amendments will be made in Subpart B of Part 1910, and amendments to delete the superseded standards will be made in 29 CFR 1926.55 and in similar sections of Parts 1915–1918.

The accompanying document is a proposed standard issued pursuant to sections 6(b) and 8(c) of the Act. The agency requests the submission of written comments, data, and arguments from any interested persons on the issues addressed or implicit in the proposal. In addition, interested persons may also file written objections to the proposal requesting an informal hearing with respect thereto.

The proposed new standard would retain the current eight-hour time-weighted average limit for exposure to airborne concentrations of TCE of 100 parts per million (ppm) as presently listed in Table Z–2, and would reduce the ceiling limit from 200 ppm to 150 ppm. In addition, the acceptable maximum peak of 300 ppm for five minutes in any two hour period would be deleted. Moreover, the proposed standard would add detailed requirements on measuring employee exposures, methods of compliance, respiratory protection, hazardous and emergency situations, protective equipment, housekeeping, training, signs and labels, medical surveillance, and recordkeeping.

The issues raised in the proposal include, among others, the following:

1. The selection of an appropriate time-weighted average and a ceiling level for TCE;

2. The possibility that TCE may be an animal carcinogen, and, if so, whether it should be treated as posing a carcinogenic risk to humans;

3. The requirement for shielding and ventilation in hazardous operations to prevent employee exposure to the breakdown products of TCE;

4. The provisions for, among other things, employee exposure measurements, methods of compliance, medical surveillance, and protective equipment and clothing, hygiene facilities, signs and labels and recordkeeping;

5. Whether it is appropriate to permit initial determinations to be made without monitoring, or whether initial monitoring should be required in all cases; and

6. The environmental and inflationary impact of this proposal.

In the development of this proposal, OSHA has considered recommendations contained in the document "Criteria for a Recommended Standard . . . Occupational Exposure to Trichloroethylene," which was developed for the Secretary of Labor by the National Institute for Occupational Safety and Health (NIOSH), Department of Health, Education, and Welfare, as well as numerous reference works, studies, case histories, and journal articles, many of which are included in the reference section of this notice.

I. Introduction

A. *Background.* Trichloroethylene ("TCE"), Chemical Abstracts Service Registry Number 76016, is a clear, colorless, noncorrosive, nonflammable liquid with the "sweet" odor characteristic of chlorinated hydrocarbons. It is primarily produced by chlorination and oxyhydrochlorination of ethylene. Although TCE is not highly reactive, it does slowly decompose upon exposure to light and water vapor to form hydrogen chloride and, at elevated temperatures, chlorine. Upon contact with certain metals, open flames or ultraviolet radiation, TCE decomposes almost instantly to form phosgene and/or hydrogen chloride. It may also react with strong alkalis to form the very toxic substance, dichloroacetylene, and other explosive mixtures (*1*).

Annual production of TCE in the United States is on the order of 2.34×10^8 kg or about 234,000 metric tons. Approximately 90 percent of the substance consumed in the United States is used as a solvent in vapor degreasing operations. Five percent is used as a dry-cleaning solvent or as an extractive solvent, especially in processes which require the selective extraction of medicines and foods. The remainder is utilized as a solvent or chemical intermediate in a variety of operations including the production of pesticides, waxes, gums, resins, tars, paints, varnishes and specific chemicals, such as chloroacetic acid (*1*). TCE has also found application as a general anesthetic and analgesic (*1, 8*).

B. *History of Regulation.* In 1943, the U.S. Public Health Service published a "Manual of Industrial Hygiene and Medical Service in War Industries," which listed maximum allowable concentrations for workplace air contaminants. For TCE, the limit listed in the manual was 200 ppm based on an eight-hour daily exposure.

As noted in the NIOSH Criteria Document, the list of concentrations in this manual was critically reviewed, unified, and extended by Cook in 1945. Cook supplemented the Public Health Service's list with lists of acceptable concentrations supplied by other sources, including the California Industrial Accident Commission, the American Standards Association and the states of Connecticut, Massachusetts, New York, Oregon and Utah. All of these sources listed a value of 200 ppm for TCE. Cook considered these sources and the works of Seifter, Morse and Goldberg when he also recommended a maximum allowable concentration of 200 ppm (*39*).

In 1946, the American Standards Association's (now the American National Standards Institute or ANSI) Z–37 Committee published a standard for exposure to TCE which recommended a maximum exposure of 200 ppm as averaged over an eight-hour day. However, in 1967, this limit was changed to 100 ppm with a ceiling limit of 200 ppm. Further, the revised standard allowed peak exposures to concentrations of 300 ppm for a duration of not more than five minutes, provided these levels were not encountered more than once in two hours during an eight-hour workday.

During the years 1947 through 1961, the American Conference of Government Industrial Hygienists (ACGIH) listed a Threshold Limit Value (TLV) for TCE of 200 ppm. In 1961, based on the work of Adams et al., ACGIH lowered its TLV to 100 ppm (*1*). Adams has reported that there was an extremely low probability of adverse effects on human subjects if the vapor concentrations of TCE were kept below 100 ppm.

The Hygienic Guides Committee of the American Industrial Hygiene Association also recommended a time-weighted average concentration of 100 ppm for an eight-hour workday with fluctuations to be kept below 200 ppm (*1*).

In 1972, under the section 6(a) rulemaking procedures of the Act, OSHA adopted the ANSI standard for exposure to TCE of 100 ppm as averaged over an eight-hour workday, a 200 ppm acceptable ceiling concentration and allowance for peak exposures of 300 ppm occurring not more frequently than five minutes in any two hours. This is the current OSHA standard for occupational exposure to TCE, found in Table Z–2 of § 1910.1000. As noted, the proposal would retain the 100 ppm time-weighted average and would reduce the permissible ceiling concentration to 150 ppm, and would delete the peak exposure concentration.

II. Toxicology

A. *Effects of Trichloroethylene.* The predominant effect of overexposure to TCE appears to be depression of the

central nervous system. Such exposures often result in visual disturbances, mental confusion, fatigue, tremors, dizziness, nausea and vomiting (*1, 3, 14*). Continued overexposure may produce unconsciousness eventually leading to death.

TCE also has toxic action on the cardiovascular and gastrointestinal systems. Deaths have been reported from ventricular fibrillation and cardiac arrest following severe exposure to the substance (*1, 16, 21*). Cases of injury to the liver and kidney have also been observed (*18, 19, 20*).

Chronic exposure to the substance may produce double vision, changes in color perception, blindness, loss of coordination and sense of smell, and impairment of the tactile sense (*1, 21, 29*).

Effects of TCE on the skin and eyes include reddening and dermographism, contact skin burns and generalized dermatitis (*29, 30*). Studies have indicated that TCE is not significantly absorbed through the skin unless it is trapped against the skin, as for example under tight clothing (*25*).

TCE is rapidly absorbed by the lungs with 50–70 percent being retained and metabolized in the body. The metabolites excreted include monochloroacetic acid, accounting for 4 percent of the retained TCE; trichloroacetic acid, 10–30 percent; and trichloroethanol, 32–59 percent. There is an initial conversion to chloral hydrate, a sedative-hypnotic. This converts into trichloroacetic acid and trichloroethanol, which are then excreted in the urine (*1*). Because the metabolism has a requirement for the reduced form of nicotinamide adenine dinucleotide phosphate (NADPH) and oxygen, it is felt that TCE is metabolized in the liver microsomes by enzymes known as the mixed-function oxidase system (*33*). This has been verified by the studies of Byington and Leibman (*31, 32*).

The biological half-life of TCE is approximately 41 hours, which suggests that TCE may accumulate in the body (*34*). Because of this fairly extended half-life, the effects of TCE may depend upon the duration as well as the intensity of exposure. A study by Grandjean showed that as the duration of exposure increases, the rate of incidence of various nervous disorders also increases (*3*).

B. *Animal Studies.* The bulk of animal study data is concerned with either the systemic toxicity or neurotoxicity of TCE.

In a 1944 study, which attempted to demonstrate a relationship between exposure to TCE and hepatic injury, Seifter reported that dogs exposed by inhalation to levels ranging from 150 ppm to 300 ppm showed no liver injury. Dogs exposed to concentrations of 500–750 ppm showed a progressive impairment of liver function, with the degree of toxic effect directly proportional to the intensity of exposure. However, the changes in liver function were transient, returning to normal within five weeks after discontinuance of TCE exposure (*9*).

In a study by Wirtschafter and Cronyn, rats given a single subcutaneous injection of TCE (0.004 mole/kg) showed elevated serum glutamic oxalacetic transaminase (SGOT) values during the 12th to 16th hours following the injection. Also, histological examination showed "mild degenerative changes of the liver parenchyma" at the 12th hour following injection (*10*). As in the Seifter study, the changes were transient, returning to normal by the 24th hour.

In 1967, Mazza and Brancaccio examined the myelograms and blood indices of rabbits exposed to 2790 ppm of TCE by inhalation. An increase in lymphatic and reticuloendothelial cells, hypoplasia of erythroblastic parenchyma, leukopenia and thrombocytopenia were found. In addition, the investigators found a severe normochromic anemia which they attributed to the toxic action of TCE on bone marrow (*45*).

A study by Battig and Grandjean (1963) examined the effects of chronic exposure to TCE vapors on rat behavior. Ten rats, exposed to an eight-hour average concentration of 400 ppm TCE, five days per week, for 14 weeks, were subjected to four tests. The rats' performances in swimming, a Hebb or rat "intelligence" test, exploratory behavior, and conditioned avoidance response tests were compared against the performance of ten control rats exposed only to fresh air. The researchers found that chronic exposure to TCE vapors detrimentally affected the rats neuromuscular efficiency in the swimming tests, but enhanced exploratory behavior performance in a maze situation. These results appeared to stem from the narcotic effects of TCE, which reduce both neuromuscular coordination and inhibitions. However, exposure to TCE did not appear to affect performance in either the intelligence or conditioned avoidance response tests (*26*).

Although TCE alone is initially a strong depressant on the central nervous system, its toxic effects are compounded by the fact that one of its primary metabolites, trichloroethanol, is six times as strong a depressant. This has been verified in studies done using guinea pigs (*37*). As one-third to one-half of the retained amount of TCE is metabolized to trichloroethanol, this quantity in combination with chloral hydrate, a hypnotic, probably contributes to the pharmacodynamic and toxic effect of TCE.

In a 1960 study, Grandjean investigated the effect of TCE vapor inhalation on food-motivated conditioned responses in rats. The animals were conditioned to climb a rope in order to reach food. Grandjean found that rats exposed to TCE climbed more frequently without previous signals than did the control rats. He observed that TCE in the doses studied (200 and 800 ppm) modified the psychological equilibrium of the rats by decreasing inhibitions and increasing excitability (*35*).

Adams et al. (1951 studied the effects of TCE inhalation on various animal species. The study sought to determine both the quantitative measures of acute toxicity by using single exposure tests on rats and the effects of chronic toxicity by using repeated exposure tests on several species.

In the single exposure tests, groups of rats were exposed to various concentrations of TCE vapor ranging from 100 to 20,000 ppm for periods of six minutes to 20 hours to determine (1) the lowest exposure at which all the animals would die, (2) the highest exposure at which all the animals would survive, and (3) the highest exposure at which all the animals would survive and remain free of organic injury. No testing was performed to determine functional impairment. The results were plotted on a graph, and typical results showed that 100 percent survival was achieved at 20,000 ppm for 24 minutes, 12,000 ppm for 36 minutes, 6400 ppm for 84 minutes and 3000 ppm for seven hours. No organic injuries were found at 20,000 ppm for 18 minutes, 12,000 ppm for 36 minutes, 4800 ppm for 84 minutes, and 3000 ppm for five hours.

Of the rats that survived, the only toxic effects observed were depressions of the central nervous system (anesthetic effect), from which the rats recovered rapidly. Other effects noted were some loss of body weight and minor tissue changes which were considered insignificant by the authors.

Adams' test for chronic toxicity was performed on rats, rabbits, monkeys and guinea pigs. They were exposed to various concentrations up to 3000 ppm of TCE for seven hours a day, five days a week for six months. Not all species were exposed to all concentrations. Maximum TCE concentrations inhaled without adverse effects were 400 ppm for the monkeys, 200 ppm for the rats and rabbits and 100 ppm for the guinea pigs. Above these concentrations the same adverse effects observed in the single exposure test were noted, and minor importance was likewise ascribed to them.

Comparing these results with existing human studies, Adams concluded that "for uniform daily exposure of about seven hours' duration there is little probability of any adverse effects on human subjects if trichloroethylene concentrations are kept below 200 ppm; the probability of any effect whatsoever is extremely small if concentrations are kept below 100 ppm." (*36*).

C. *Human Studies.* Much research has been conducted on human subjects' response to TCE exposure. The following studies are representative of the literature that OSHA has relied upon in developing this proposed standard.

While attempting to devise tests that would be sensitive enough to measure changes in psychophysiological functions of a single subject exposed to low vapor concentrations of TCE (100, 200, 300, and 500 ppm), Stopps and McLaughlin (1967) found that psychomotor performance on various tests was not significantly affected at 100 ppm, but did deteriorate as the concentration of TCE was increased. Between 100 and 200 ppm, a slight decline in performance was observed, and in one test, a manual dexterity test, no difference in results was found. At the 300 and 500 ppm concen-

trations, declines in performance were significantly pronounced.

At all exposures, the subject reported "a slight tendency toward somnolence, and, in addition, at the 500-ppm concentration, mild irritation in the upper respiratory tract and a dull woolyheaded feeling."

Dr. Richard D. Stewart of the Medical College of Wisconsin, has conducted extensive research on TCE exposure. In a 1970 study, Stewart et al. tested for neurophysiological effects of TCE exposure. In nine separate experiments, he exposed subjects to 200 ppm for seven hours for five days. Some subjects reported a variety of mild subjective symptoms such as throat and eye irritation. Yet these subjects did not again experience these symptoms when exposed to TCE on consecutive days. All of the subjects, however, reported feelings of fatigue and sleepiness. Further, although the investigators found normal results on all performance tests taken by the subjects, 50 percent of the subjects reported that a greater effort was required for them to perform normally in a modified Romberg test for coordination (*24*).

Salvini, Binaschi and Riva (1971) studied the performances of six male university students exposed to average concentrations of 110 ppm in tests of perception, memory, and manual dexterity. The subjects were exposed to TCE in two four-hour sessions separated by one and one-half hours. The investigators found a "statistically significant decrease in performance ability when the subjects were exposed to TCE, indicating that 100 ppm was very close to the average concentration capable of interfering with psychophysiological efficiency."

In an attempt to test their findings, the investigators repeated the entire experiment using workmen who regularly worked with TCE. The results of the second experiment confirmed the conclusions drawn from the results of the tests with university students (*7*).

An expanded version of the Salvini experiment was performed by Stewart et al. (1974), but failed to corroborate Salvini's findings of interference with pyschophysiological efficiency at 110 ppm. Stewart et al. attributed the different results to three possible deficiencies in the Salvini study: ". . . questionable statistical analysis of the data, an inaccurate TCE vapor exposure, or poor experimental execution. . . ." (*28*).

Foster, Newton, Soto, and Stewart (1974) conducted a study to determine the effect of daily exposure to low levels (20, 100, 200 ppm) of TCE on the spontaneous and evoked electrical activity of the brain. The exposures resulted in electroencephalogram (EEG) changes at 200 ppm in one of the six (three male, three female) subjects. Exposure to 100 ppm for one week resulted in a reduced amplitude in the Visual Evoked Response (VER) readings for all of the female subjects. Exposure to concentrations of TCE at 100 and 200 ppm resulted in a reduced amplitude in the VER readings for only one of the three male subjects. As a result of these responses, the researchers hypothesized that "TCE may . . . directly stimulate cortical neurons and/or it may influence subcortical facilitory or inhibitory centers." (*28*). At this time it is unknown what effect, if any, these changes have on the health of employees. However, as Stewart noted, at concentrations of 300 or 400 ppm, the changes could become sufficiently significant to suggest harmful effects.

In all of Stewart's work he did not find ". . . that TCE has a well defined deleterious effect upon humans either at 100 ppm or 200 ppm in the atmosphere for the 7½ hour per day, 5 days per week." He concluded that ". . . the 100 ppm concentration probably has a three- to four-fold margin of safety for most individuals." (*28*).

In a review of the criteria document published by NIOSH, Messite (1974) cited several authors in establishing her reasons for lowering the TWA to 75 ppm (*14*). She stated that:

> . . . the psychophysiological effects of human exposures to trichloroethylene at levels approximately those of the proposed standard and the clinical impressions expressed by a number of other authors of subjective symptoms . . . do not appear to be sufficiently appreciated in the document.

Among the authors primarily relied upon were Grandjean (1955) and Bardodej (1955).

Grandjean et al. made 96 air analyses in 24 different workshops which showed concentrations of TCE between 1 and 355 ppm, with the majority between 20 and 40 ppm. Either through case histories (30 people) or clinical examinations (50 people), Grandjean found symptoms such as fatigue, dizziness, and inability to tolerate alcohol among exposed employees.

Grandjean pointed out that the air monitoring "provided insufficient indication of the total extent of exposure of the workers," because there was no long term air sampling and the ten minute air samples did not fully take into account such job tasks as special tank cleaning, removal of TCE, etc. Both because the study did not measure the extent of employee exposure and because there was no control group, this study cannot be utilized to definitely establish a dose-response level for TCE (*3*).

In concluding that NIOSH should have recommended a level of 75 ppm, Messite also relied upon a study by Bardodej and Vyskocil (*46*). Seventy-five workers employed in dry-cleaning and degreasing occupations were studied. The workers' length of employment varied from six months to 25 years. The authors reported that the TCE concentrations in the plants ranged between 5 and 630 ppm. They found a statistically significant correlation between the duration of exposure and toxic effects of TCE. NIOSH, in its review, criticized this report because "no controls were used, the areas sampled were not reported, and the general health of the worker population was not given." Therefore, this study is also not that helpful in establishing a dose-response level for TCE.

Effects of exposure to TCE on the skin and eyes have also been studied by Stewart. In 1964, Stewart and Dodd published results of investigations of the rate of skin absorption for five industrial solvents including TCE. Volunteer subjects were exposed by immersion of the thumbs into containers of the substances for 30 minutes. The amount of skin absorption was estimated by comparing concentrations of the solvents found in the expired alveolar breath of the subjects following the skin exposure, with previously obtained data on alveolar breath concentrations following exposure to known vapor levels of the solvents.

All of the subjects experienced burning sensations during skin contact with TCE. Erythema and fine scales were also noted in all subjects with the erythema subsiding in two hours. The researchers found that the rate of skin absorption of TCE was comparatively slow, and hypothesized that the substance would probably not be absorbed through the skin in toxic quantities during similar contact with hand and forearms (*25*).

In one study, mild eye irritation was reported for exposures as low as 160 ppm for a total exposure period of 83 minutes (*43*).

D. *Case histories.* Most of the facts obtained concerning the effects of occupational exposure to TCE have come from case histories. Although these case histories are important, they often involved exposures to high, although unknown, concentrations.

For example, there are numerous reported cases of deaths from inhalation of TCE vapors during degreasing operations (*16, 18, 19, 21*). There are also reports of deaths resulting from the intentional "sniffing" of TCE vapors by workers and children (*15, 23*). Other effects noted from case histories such as nausea, dizziness, sleepiness, etc., parallel effects seen under the controlled-condition studies. Effects such as renal and hepatic failures due to either occupational or deliberate inhalation of TCE vapors have not been seen in human experimental studies, but are readily apparent in the case histories (*17, 19, 20*). Acute illnesses have been documented by reports of unconsciousness among workers exposed to concentrations between 1,700 and 3,300 ppm for as little as ten minutes (*29*) and dysfunctions of the central nervous system at exposures of 1,000 ppm for even short periods of time (*42*).

While these case studies are useful in identifying severe symptoms of exposure to extremely high levels of TCE, they are not helpful in determining the lower toxic limits of TCE exposures.

III. The Consideration of Carcinogenicity

OSHA has received an alert as to the potential carcinogenicity of TCE from the National Cancer Institute (NCI) and from NIOSH. Both alerts, which were based on a carcinogenesis bioassay of TCE conducted by NCI, state that a preliminary evaluation of the bioassay indicates the substance to be carcinogenic in mice. However, NCI emphasized that

its memorandum represents "only a statement of concern" and that "no definite conclusions as to the carcinogenicity of the substance may be reached until all of the data from histopathology examinations have been received and evaluated." NIOSH's memorandum was based upon the same NCI study and was intended to "alert members of the occupational and health community to new information on a potential occupational hazard."

OSHA shares the concern expressed by NCI and NIOSH as to the possible carcinogenicity of TCE. However, we believe it is inappropriate at this time to treat TCE as a human carcinogen based solely on the preliminary information now available. OSHA solicits and will give serious consideration to all data concerning the carcinogenic potential of TCE, including data on whether TCE is an animal carcinogen and other data which may indicate that TCE should be regulated in the workplace as a carcinogen. If the evidence submitted during the course of this rulemaking proceeding, including the final NCI data, indicates that TCE should be regulated as a carcinogen, the final standard promulgated as a result of this proceeding may set a maximum exposure limit significantly below the limit set out herein. In addition to possibly requiring employers to reduce exposures to the lowest feasible level, the final standard may, in the circumstances noted above, contain other provisions, such as for regulated areas, appropriate to the regulation of a carcinogen (see, e.g., 29 CFR 1910.1017).

In any event, we solicit any data, views or arguments on the issue of carcinogenicity, feasibility and related matters.

IV. Pertinent Legal Authority

The primary purpose of the Act is to assure so far as possible safe and healthful working conditions for every working man and woman. One means prescribed by Congress to achieve this goal is the authority vested in the Secretary of Labor to set mandatory safety and health standards. The standards-setting process under section 6 of the Act is an integral part of an occupational safety and health program in that the process permits the participation of interested parties in consideration of scientific data, industrial processes and other factors relevant to the identification of hazards and the selection of appropriate control measures. Occupational safety and health standards establish the requisite conduct or exposure level and provide a basis for ensuring the existence of safe and healthful workplaces.

The Act provides that:

> The Secretary, in promulgating standards dealing with toxic materials or harmful physical agents under this subsection, shall set the standard which most adequately assures, to the extent feasible, on the basis of the best available evidence, that no employee will suffer material impairment of health or functional capacity even if such employee has regular exposure to the hazard dealt with by such standard for the period of his working life. Development of standards under this subsection shall be based upon research, demonstrations, experiments, and such other information as may be appropriate. In addition to the attainment of the highest degree of health and safety protection for the employee, other considerations shall be the latest available scientific data in the field, the feasibility of the standards, and experience gained under this and other health and safety laws. (Section 6(b)(5))

Sections 2(b) (5) and (6), 20, 21, 22, and 24 of the Act reflect Congress' recognition that conclusive medical or scientific evidence including causative factors, epidemiological studies or dose-response data may not exist for many toxic materials or harmful physical agents. Nevertheless, standards cannot be postponed because definitive medical or scientific evidence is not currently available. Indeed, while final standards are to be based on the best available evidence, the legislative history makes it clear that "it is not intended that the Secretary be paralyzed by debate surrounding diverse medical opinion." House Comm. on Education and Labor, H.R. Rep. No. 91–1291, 91st Cong., 2d Sess. 18 (1970). This congressional judgment is supported by the courts which have reviewed standards promulgated under the Act. In sustaining the standard for occupational exposure to vinyl chloride (29 CFR 1910.1017), the U.S. Court of Appeals for the Second Circuit stated that "it remains the duty of the Secretary to act to protect the workingman, and to act even in circumstances where existing methodology or research is deficient." "Society of Plastics Industry, Inc. v. Occupational Safety and Health Administration," 509 F. 2d 1301, 1308 (2d Cir. 1975), *cert. denied*, — U.S. —, 95 S.Ct. 1998, 44 L.Ed.2d 482 (1975).

A similar rationale was applied by the U.S. Court of Appeals for the District of Columbia Circuit in rereviewing the standard for occupational exposure to asbestos (29 CFR 1910.1001). The Court stated that:

> some of the questions involved in the promulgation of these standards are on the frontiers of scientific knowledge, and consequently as to them insufficient data is presently available to make a fully informed factual determination. Decision making must in that circumstance depend to a greater extent upon policy judgments and less upon purely factual analysis.

"Industrial Union Department, AFL–CIO v. Hodgson," 499 F.2d 467, 474 (D.C. Cir. 1974).

In setting standards, the Secretary is expressly required to consider the feasibility of the proposed standards. Senate Comm. on Labor and Public Welfare, S. Rep. No. 91–1282, 91st Cong., 2d Sess. 58 (1970). Nevertheless, considerations of technological feasibility are not limited to devices already developed and in use. Standards may require improvements in existing technologies or require the development of new technology. "Society of Plastics Industry, Inc. v. Occupational Safety and Health Administration," 509 F.2d at 1309.

Where appropriate, the standards are required to include provisions for labels or other forms of warning to apprise employees of hazards, suitable protective equipment, control procedures, monitoring and measuring of employee exposure, employee access to the results of monitoring, and appropriate medical examinations. Where a standard prescribes medical examinations or other tests, they must be made available at no cost to the employee (Section 6(b)(7)). Standards may also prescribe recordkeeping requirements where necessary or appropriate for enforcement of the Act or for developing information regarding occupational accidents and illnesses (Section 8(c)).

V. The Proposal

The following discussion analyzes significant provisions of the proposed standard for occupational exposure to TCE:

A. *Scope and application.* The proposed standard would apply to all workplaces in all industries, including construction and maritime as well as "general industry," where TCE is produced, released, packaged, repackaged, stored, handled, used or transported, except to the extent that this section will not apply to working conditions with respect to which other Federal agencies, such as, but not limited to, the Environmental Protection Agency or the Department of Transportation, have exercised their statutory authority to prescribe or enforce standards affecting occupational safety or health. Although the scope of this proposal is broad, covering nearly every use or handling of TCE, the specific provisions of the proposed standard that would apply to any particular employer depend upon the amount of the toxic substance actually released into the workplace air, or upon whether employees are likely to have eye or repeated skin contact with liquid TCE. It should be noted, however, that certain provisions of the proposed standard, such as employee training and information, apply wherever TCE is relased as a result of operations, without regard to the airborne concentrations.

B. *Exposure limits.* The proposed standard establishes limits for exposure to airborne concentrations of TCE and for dermal and eye exposure.

1. *Permissible airborne exposure limits.* The proposed standard would retain the eight-hour time-weighted average limit (TWA) based on a 40-hour work week of 100 parts of TCE per million parts of air (100 ppm) currently listed in § 1910.1000, Table Z–2. However, the 200 ppm ceiling concentration currently listed in § 1910.1000 would be changed to 150 ppm, as averaged over a 15 minute period, and the concept of a peak concentration would be completely eliminated.

Based on the studies discussed above, it is OSHA's judgment that there is a significant probability that well-defined symptoms of TCE exposure will appear in employees exposed to approximately 300 ppm or greater. In addition, fatigue and sleepiness, probably resulting from the anesthetic effects of TCE, have been observed at 200 ppm. There are also data

to suggest that milder symptoms and effects may appear at levels below 200 ppm, although probably not under 100 ppm.

It is apparent that we must protect against well-defined symptoms of TCE exposure. Moreover, we believe that it is inappropriate to permit employees to be exposed to a known anesthetic at levels which produce even mild anesthetic effects, such as fatigue and sleepiness. Therefore, in OSHA's judgment and in accordance with NIOSH's recommendations, the current TWA for TCE appears to be both necessary and adequate for the protection of employees. We believe the proposed TWA provides an appropriate margin of safety to protect employees from well-defined symptoms of TCE exposure and from its anesthetic effects. It also provides significant protection from milder symptoms and effects.

However, as previously mentioned, studies indicate that the current ceiling level of 200 ppm may be too high. Thus, for example, subjects exposed to concentrations between 150 and 200 ppm experienced eye irritation, fatigue and sleepiness even when exposure durations were for less than eight hours, and especially when continued for five days per week. Therefore, OSHA proposes to set the ceiling limit, as averaged over any 15 minute period, at 150 ppm to protect workers from experiencing toxic effects from exposure.

2. *Dermal and eye exposure limit.* As in the case of most organic solvents, TCE acts as a defatting agent on skin tissues, resulting in irritation and dermatitis. Repeated or prolonged exposures may even result in skin burns. Eye contact with TCE results in severe pain and irritation often lasting for several days.

For these reasons, the proposed standard would prohibit employers from exposing employees to eye and repeated skin contact with liquid TCE.

C. *Effects of overtime on exposure.* The permissible exposure limits are based on an eight-hour time-weighted average (TWA) concentration for a 40-hour work week. OSHA recognizes, however, that work shifts can extend beyond the regular eight-hour period as the result of overtime or other alterations of the work schedule. This extension of work time also extends the time during which the employee is exposed. The effects of this additional exposure time must be considered in arriving at a level of exposure.

For the purpose of calculating an exposure level, the relationship of concentration and time of exposure has been assumed to be linear. As the exposure time increases, the factor of concentration multiplied by time (C x T) must remain constant. Thus, for example, employees exposed to TCE for ten hours could not be exposed to more than 80 ppm on the average.

It is believed that by equating exposure with the eight-hour TWA, reasonable assurance of maintaining a safe exposure level is retained.

D. *Action level.* In addition to time-weighted average and ceiling limits, the proposed standard prescribes an action level which is a concentration of TCE equal to one-half of the TWA, at or above which certain precautionary measures such as exposure measurements and medical surveillance must be initiated.

The proposed action level for TCE is any concentration greater than or equal to 50 parts per million (50 ppm). Like the TWA, the action level is based on an eight-hour time-weighted average.

In OSHA's judgment, two kinds of uncertainties can affect an employer's efforts to be reasonably confident of the results of his exposure measuring program. First, he must know if his sampling and analysis accurately informs him of his employee's actual exposure level on the day of measurement. Assuming that an employee's exposure has been properly measured (excluding such things as precision and accuracy of the sampling method) an employer can be reasonably sure of the employee's exposure on the day of measurement.

Second, the employer must also know whether the measured exposure level on one day is indicative of exposure levels on days he does not measure. It is known that the level of contamination in occupational environments varies from day to day in a random fashion. This variation in levels is unavoidable; it is only minimally connected to the precision and accuracy of the method of measurement, and does not include variations due to changes in work processes or controls.

OSHA has determined statistically that even though all measurements of exposure level may fall below the permissible limit, some possibility exists that on unmeasured days the employee's actual exposure may exceed the permissible limit. (Leidel, N.A. et al. "Exposure Measurement Action Level and Occupational Environmental Variability," DHEW, PHS, CDC, NIOSH, DLCK (August 1975).) Where exposure measurements are above one half the permissible limit, i.e., the action level, the statistical risk is such that an employer can not reasonably be confident that his employees may not be overexposed. Therefore, requiring exposure measurements to begin at the action level provides the employer with a reasonable degree of confidence in the results of his measurement program.

In view of these considerations and in order to provide maximum employee protection, the proposal would also require the employer to commence medical surveillance at the action level.

E. *Determination and measurement of exposure.* The employer would be required by the proposal to make an initial determination of employee exposure to airborne or liquid TCE. This determination may be an observation based on the amount of TCE present in the workplace, type of operations being performed, the amount and type of ventilation, and the proximity of employees to the TCE. Also, the employer's determination must consider any employee complaints of symptoms that may be attributable to TCE exposure.

When making this determination, the employer is not required to sample or measure airborne concentrations of TCE. However, if the employer has performed any measurements, these must also be considered in the initial determination. In making the initial determination, the employer must be certain that the determination accurately reflects employee exposure conditions over the entire workday.

In establishments having more than one work operation involving the use of TCE, an initial determination must be made for each operation. Also, the determination must be repeated each time there is a change in production, process or control measures which could result in new or additional exposures, or whenever the employer has any other reason to suspect that a change in exposure conditions has occurred.

If the results of the initial determination are negative, that is, if the employer determines that no employee is exposed to eye or repeated skin contact and that no employee is exposed to airborne concentrations of TCE vapor at or above the action level or above the ceiling limit, a written record of this determination must be made. This record must contain any information or observations that indicate an employee may be exposed to liquid or airborne concentrations of TCE, including employee complaints of symptoms that may be attributable to such exposure. Further, the determination record must include measurements of TCE that have been made, even though such measurements are not required to be made for the initial determination, and the names and social security numbers of the employees considered in reaching the determination.

When results of the initial determination of dermal or eye exposure indicate that any employee may be exposed to liquid TCE, the employer must provide affected employees with impermeable protective clothing and devices to protect the areas of the body likely to come in contact with liquid TCE.

When the initial exposure determination indicates that any employee may be exposed in excess of the action level, the employer must measure the exposure of the employee most likely to have the highest exposure. If the results of this measurement indicate that the employee is exposed to concentrations in excess of the action level, or the ceiling limit the employer must implement a program to measure the exposures of all employees similarly affected. Because a positive determination triggers the exposure measurement program, with its own record-keeping requirements, no written record of positive determination need be made.

When the results of the single employee's exposure measurement reveal exposures in excess of the action level or the ceiling limit, the employer would be required to identify all other employees who may be similarly exposed, and to measure the exposures of each of these employees. Detailed instructions for monitoring the exposures of such employees are contained in the proposed standard.

The measurement procedure may be terminated as to a particular employee if the employee exposure measurement does not indicate exposures in excess of the action level or ceiling limit. However, it should be noted that if an employer has knowledge of a change in production, process or control measures which could result in increased exposures to TCE, or if the employer has any other reason to suspect that a change in exposure conditions has occurred, the initial determination procedure must be repeated.

The monitoring provisions are designed so that employers who have workplaces in which exposures to TCE are below the action level would not be required to make continual measurements. Further, those employers having establishments with exposures at or above the action level, but below the permissible exposure limits, would be required to make only the minimum number of exposure measurements necessary for protection of employees. The intent of these procedures is to provide adequate protection for employees while minimizing the burden on employers.

F. *Methods of measurement.* The proposal would require that exposure measurements reflect the actual exposure conditions for each employee. No specification is made for the location of the samples taken. Thus, the employer may perform either personal breathing zone or general air sampling, provided that the method chosen gives an accurate indication of each employee's exposure. Further, any appropriate combination of long-term or short-term samples would be acceptable. However, the proposal requires that all exposures be calculated on an eight-hour time-weighted average basis, with the exception of the ceiling concentration measurements. The sampling method must have an accuracy, to a confidence level 95%, of ± 35% up to 100 ppm and ± 25% above 100 ppm. The term "accuracy" refers to the difference between the measured value and the true concentration. It allows for both the random variation of the method (its precision) and the difference between the average result from the method and the true value (bias of the method). As noted, the required accuracy for concentrations of TCE above 100 ppm is 25% at a 95% confidence level. This means that out of a long series of measurements, 95% must be within 25% of the true value.

G. *Methods of compliance.* The proposed standard would require the employer to immediately institute engineering controls to reduce employee exposures to or below the permissible exposure limits, except in situations where such controls are infeasible. Further, in situations where the engineering controls that can be instituted immediately will not reduce exposures to the permissible exposure limits, they must nonetheless be used to reduce exposures to the lowest practicable level, and be supplemented by the use of work practices.

Where engineering controls and work practices will not reduce exposures to the permissible exposure limits, they must nonetheless be implemented to reduce exposures to the lowest practicable limit, and be supplemented by the use of personal protective devices. In addition, a program must be established and implemented to reduce exposure to within the permissible exposure limits, or to the greatest extent feasible, solely by means of engineering controls. Written plans for this program must be developed and furnished upon request for examination and copying to representatives of the Secretary and the Director. These plans must be reviewed and updated periodically to reflect the current status of exposure control.

In the compliance priorities set out in the proposal, engineering controls are the preferred means of compliance because they reduce exposure hazards in the workplace environment by removing the airborne contaminants. Engineering controls may include the installation of local exhaust ventilation or the modification of a process so as to reduce emission of the contaminant into the workplace. When mechanical ventilation is used for engineering control, checks of air system efficiency, such as capture velocity, duct velocity or static pressure must be made at least every three months. These checks are necessary to assure that the primary control system (mechanical ventilation), is functioning effectively at all times.

When engineering controls prove to be infeasible or inadequate, work practice controls must be instituted. Work practice controls include, for example, adherence to proper process techniques and proper maintenance. However, the effectiveness of work practice controls is dependent on strong supervisory controls being continuously maintained, and they are therefore generally less reliable than engineering controls. For this reason the proposal establishes work practice controls as the secondary means of controlling employee exposures.

Where both engineering and work practice controls are infeasible or insufficient to reduce the exposure to permissible levels, they must nonetheless be used to reduce exposure to the lowest practicable level, and be supplemented by the use of respirators. Respirators are the least satisfactory means of control because of certain difficulties inherent in their use. Respirators are capable of providing good protection only if they are properly selected for the concentrations of airborne contaminants present, properly fitted to the employee, worn by the employee, and replaced when they have ceased to provide adequate protection. While it is possible for all of these conditions to be met, it is often the case that they are not, and, as a consequence, the protection of employees by respirators is not as effective as the other methods of compliance. Where respirators are used, the proposed standard would establish requirements for their selection and maintenance.

H. *Hazardous operations and emergency situations.* As discussed above, TCE decomposes rapidly into several hazardous breakdown products such as chlorine, hydrogen chloride, phosgene and dichloroacetyl chloride, upon exposure to high temperatures, open flames or ultraviolet light (*1*). For this reason, the proposed standard would require operations involving high temperatures, open flames or ultraviolet light to be performed outside of areas in which TCE vapors are present, unless such operations are appropriately shielded and ventilated.

A TWA for dichloroacetyl chloride is not included in Table Z–1 at this time, but it is known that a concentration of approximately 10 ppm will immediately cause coughing and eye irritation to an extent that most employees cannot tolerate it for more than a short time. Dahlberg states that dichloroacetyl chloride, not phosgene, is the main decomposition product caused by welding in areas where TCE vapors are present. The rate of creation of dichloroacetyl chloride is dependent on the amount of TCE present, and welding is very hazardous where levels of TCE exceed 30 ppm (*5*). Dahlberg points out that even 30 ppm may be too high in certain cases, and recommends that precautions be taken to eliminate TCE from the work area altogether. Therefore, to prevent irradiation and consequent oxidation of TCE, the proposed standard requires hazardous operations, such as welding, to be screened and adequately ventilated.

Degreasing and storage tanks which have been emptied for cleaning, maintenance or inspection purposes may contain concentrations of TCE vapors which are immediately hazardous to the lives and health of employees. For this reason, the proposed standard cross-references § 1910.94(d)(11)(ii)–(v) which contain provisions for safe entry into tanks.

I. *Employee information and training.* Information and training are essential for the protection of employees because an employee can do much to protect himself if, and only if, he is informed of the nature of the hazards in his workplace. To be effective, an employee education system must apprise the employee of the specific hazards associated with his work environment. For this reason, the employer would be required to inform each employee of the effects of TCE, the necessity for controlling exposure, the emergency procedures and the purpose and description of the medical surveillance and exposure monitory programs. Further, the employee must be instructed to report promptly the development of symptoms or conditions which could be attributed to overexposure to TCE. The proposal also contains requirements for warning signs and labels.

J. *Medical surveillance.* The proposed standard would require employers to institute a program of medical surveillance for employees who may be exposed to concentrations of TCE vapor at or above the action level or in excess of the ceiling limit. As in the case of exposure determinations, the level of an employee's exposure is considered without regard to the use of respirators. The purposes of

the medical surveillance requirements include: determining the effects of exposure on the health of employees, ensuring to the extent possible that no employee is exposed to concentrations of TCE which are above his own level of tolerance and ensuring that if symptoms of overexposure do occur, they are recognized as early as possible and that appropriate action is taken.

The proposal requires a comprehensive medical and work history to be taken at the time of initial assignment or upon institution of the medical surveillance program. The purpose of these histories is to identify those individuals whose past experiences indicate hypersusceptibility to various chlorinated hydrocarbons and whose exposures, therefore, might need to be reduced.

The proposal also calls for an initial and an annual medical examination which must include an electrocardiogram, pulmonary function testing, urinalysis and a complete blood count. Because exposures to TCE have been reported as the cause of cardiac arrhythmias in some workers, the electrocardiogram is necessary for identifying workers with heart problems that might be affected by TCE exposure. Also, since TCE is a chlorinated solvent, overexposure has the potential for causing liver and kidney impairments. Urinalysis is useful for screening for individuals who have or may develop liver or kidney dysfunctions. Pulmonary function testing is necessary for determining whether an employee is able to wear certain types of respiratory protective equipment.

Although the proposal specifies the type of medical tests and examinations to be given affected employees, the employer may allow the examining physician to use other types of medical examinations, provided the alternative procedures can give at least equal assurance of detecting medical conditions pertinent to protecting employees against TCE exposure. If the examining physician elects to use such alternative medical examinations, the employer must obtain a statement from the physician setting forth the alternative medical examinations to be used and the rationale for their substitution and submit that to the Secretary. The employer must also inform affected employees that medical examinations other than those prescribed in the standard are to be made available.

The employer must provide the examining physician with a copy of the standard for TCE, including appendixes, a description of the employer's duties, a description of any personal protective equipment used by the employee, the results of the employee's exposure measurement, and an estimate of the levels to which the employee will be exposed. The employer must also provide any available employee medical history information requested by the physician.

Following the medical examination, the employer must obtain a written opinion from the examining physician stating whether the employee has any medical condition that would place him at increased risk to his health or that would be aggravated through exposure to TCE. Additionally, the opinion must state any recommended limitations upon the employee's exposure or upon the employee's use of protective equipment and respirators. The opinion must also state that the employee has been informed of any medical conditions which require further examinations or treatment, although the written opinion must not contain specific findings or diagnoses unrelated to the employee's exposure to TCE. The employer must provide a copy of the physician's opinion to the affected employee.

If, based on the physician's opinion, the employer determines that exposure of an employee to TCE would materially impair the employee's health, the employer must place specific limitations on the employee's continued exposure to TCE so as to remove the employee from increased risk.

If an employee refuses to take an examination, the proposed standard contains a provision requiring the employer to inform the employee of the risks that may be incurred by his refusal, and to obtain a signed statement from the employee attesting to the fact that the employee fully understands the potential risks, but still does not wish to be examined. The purpose of this provision is not to encourage employees to avoid medical examinations. On the contrary, OSHA believes the positive action taken by employers to inform employees of the risk involved will encourage employees to undergo the examinations.

K. *Recordkeeping.* The proposed standard would require employers to keep written records of the following: initial determinations which indicate that employees are not exposed at or above the action level or above the ceiling limit; measurements of employee exposure; tests of mechanical ventilation system efficiency (where such systems are used for engineering control); annual training and information sessions; medical examinations; and preplacement histories.

Besides showing that an employer has made an examination of the workplace, records of negative determinations also assist the employer in pinpointing areas of his operations where there might be potential for exposure above the action level in the future. Records of initial positive determinations, however, are not needed, because a positive determination requires the employer to take other actions which carry their own recording requirements.

When symptoms of organic damage appear, a physician often needs information as to the patient's previous medical conditions to make an accurate diagnosis of the problem and its apparent cause. Records of previous occupational medical examinations could be an invaluable aid to the physician treating a patient with organic damage which may be due to exposure to a toxic chemical substance. For this reason, the proposal would require the employer to retain records of employee exposure measurements and medical examinations for a period of no less than ten years, even if the employee ceases to work for the employer.

A record of the tests of mechanical ventilation system efficiency is required to be maintained so that the employer can ensure that tests of the system are being made at the required time intervals. Further, the record is useful to the employer since a comparison of the most recent test with previous tests will assist in the evaluation of the effectiveness of the ventilation system, and will enable the employer to detect any progressive loss of efficiency before it becomes critical.

Section 8(c)(3) of the Act requires, and paragraph (n) of this proposal contains provisions for access to records of exposure measurements by employees, former employees or their representatives, and for access to medical records made pursuant to paragraph (m) by physicians designated by employees or former employees. It should be noted that such access is limited only to the records of determinations, exposure measurements, and medical examinations that are being maintained by the employer in accordance with the recordkeeping requirements. It should also be noted that the employer is not required to retain or make those records accessible for periods longer than those required in paragraph (o) of the proposed standard.

The proposal provides for the transfer of monitoring and medical records, when: (1) one employer succeeds another, and (2) an employer ceases to do business and there is no successor. An employer succeeding another is merely required to receive and maintain those records which his predecessor would have been required to keep. Employers closing out their businesses without successors are required to send their records to NIOSH and notify each employee and former employees of the transfer.

OSHA is aware that certain provisions of this proposal, such as medical surveillance and the extended retention period for medical and monitoring records may pose special problems to some employers, especially those who have small numbers of employees, operate with non-fixed places of employment, or use workforces which are highly transient in nature.

This awareness has been expressed by the Department of Labor in a statement submitted to the House Subcommittee on Environmental Problems Affecting Small Business on 26 June 1975, as follows: "It has become increasingly evident that the combined body of Federal regulations imposes a substantial, and, to some extent, unnecessary burden upon employers, particularly those who run small businesses. While most of these requirements serve a necessary and useful purpose, a definite potential exists for duplication, conflicting standards, and inappropriate recordkeeping requirements. In an effort to eliminate problems where any exist in the Department of Labor, I have requested my agency heads to assess the small business impact of the laws they administer and determine what can be done to ease the burden on the small employer, while still assuring compliance with the law."

Although it is clear that OSHA's first and prime responsibility is to assure employees safe and healthful places of em-

ployment, the Act and its legislative history recognize that economic and technological feasibility are legitimate factors to be considered in the setting of occupational safety and health standards.

In addition, the Act explicitly takes cognizance of its impact upon affected small businesses, specifically with respect to any recordkeeping requirements which are imposed.

Pursuant to section 8(d) of the Act, OSHA is exploring methods of reducing, to the maximum extent possible, the administrative and economic burdens of the proposal's various recordkeeping requirements.

While the proposal does not address itself to specific alternatives, OSHA invites comments concerning options which would both provide full protection to affected employees and at the same time minimize the administrative and economic burden on affected employers—especially those with small numbers of employees, non-fixed workplaces, or highly transient workforces.

L. *Observation of monitoring.* Section 8(c)(3) of the Act requires employers to provide employees or their representatives with the opportunity to observe monitoring of employee exposures to toxic materials or harmful physical agents. To ensure that the right to observe is meaningful, observers would be entitled to receive an explanation of the measurement procedure, to observe all steps related to the measurement procedure and to record the results obtained.

It should be noted that the observer, whether an employee or designated representative, must be provided with and is required to use any personal protective devices required to be worn by employees working in the area that is being monitored, and must comply with all other applicable safety procedures.

M. *Appendixes.* Three appendixes have been included in this proposal: Appendix A, "Substance Safety Data Sheet;" Appendix B, "Substance Technical Guidelines;" and Appendix C, "Medical Surveillance Guidelines." It should be noted that the appendixes have been included primarily for informational purposes. None of the statements contained therein should be construed as establishing a mandatory requirement not otherwise imposed by the standard or as detracting from an obligation which the standard does impose.

The information contained in Appendixes A and B is meant to aid the employer in complying with requirements of the standard. This information is also to be provided to employees as part of the annual training and education program.

Appendix C gives the employer a means of providing the examining physician with an explanation of the potential health effects of TCE exposure and provides information needed by the physician to make an accurate interpretation of the medical examination results. Appendix C also lists other types of examinations, not required by the standard, which may help the physician in making an accurate assessment as to whether any limitation should be placed upon the employees exposure to TCE.

VI. Environmental Impact Assessment

The National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321–4347), requires, among other things, that Federal agencies assess their proposed major actions, including rulemaking, to determine whether a significant impact on the quality of the human environment may result. Furthermore, 29 CFR 1999.3(d) requires that where OSHA determines that an environmental impact statement should be prepared, the determination to do so must be published in the Federal Register. Accordingly, it is hereby noticed that OSHA intends to prepare an environmental impact statement on the proposed standard for occupational exposure to trichloroethylene in accordance with the requirements of 29 CFR Part 1999.

Once the draft environmental impact statement has been prepared, a copy of it will be made available by OSHA to any member of the public who requests an opportunity to comment on it. Any person or agency submitting comments on it to OSHA must at the same time forward five copies of the comments to the Council on Environmental Quality (CEQ), 722 Jackson Place NW., Washington, D.C. A 45-day period will be allowed for the submission of comments after the publication of the notice of availability of the draft environmental impact statement. The draft statement will be available, where practicable, at least 15 days prior to a public hearing on the proposed standard. The environmental impact of the proposal would be an appropriate issue at such hearing.

It appears at present that the preceding preamble to the proposed standard for occupational exposure to trichloroethylene adequately assesses the impact of the proposal on the workplace environment. It further appears that the proposed standard for occupational exposure to trichloroethylene will have no significant effects on the quality of the human environment external to the workplace. The proposal does not increase the amount of TCE permitted to be released into the ambient air, nor does the proposal call for changes of industry practice in disposal of trichloroethylene wastes. For these reasons, OSHA does not anticipate any increased impact on the community contiguous to establishments in which trichloroethylene is used or produced.

Interested persons may submit comments that may be helpful in preparing the draft environmental impact statement on the proposed standard. Any person having relevant information or data not readily available in the open literature is invited to submit it to David R. Bell, Office of Standards Development, Occupational Safety and Health Administration, U.S. Department of Labor, 200 Constitution Avenue NW., Room N3669, Washington, D.C. 20210, by November 19, 1975. Comments submitted in regard to the proposed standard need not be resubmitted. All material received on environmental impact will be available for public inspection and copying at the above address.

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VII. Public Participation

Interested persons are invited to comment on the proposed standard on or before December 19, 1975. Written data, views, and arguments concerning the proposal must be submitted in quadruplicate to the Docket Officer, Docket No. H–048, Room N–3620, 200 Constitution Avenue NW., Washington, D.C. 20210 (Telephone 202/523–8076). Written submissions must clearly identify the provision of the proposal addressed and the position taken with respect to each such provision. The data, views, and arguments will be available for public inspection and copying at the above address. All written submissions received will be made a part of the record of this proceeding.

Pursuant to 29 CFR 1911.11 (b) and (c), interested persons may, in addition to filing written comments as provided above, file objections to the proposal and request an informal hearing with respect thereto, in accordance with the following conditions:

1. The objections must include the name and address of the objector;

2. The objections must be postmarked on or before December 19, 1975;

3. The objections must specify with particularity the provision of the proposed rule to which objection is taken, and must state the grounds therefor;

4. Each objection must be separately stated and numbered; and

5. The objections must be accompanied by a detailed summary of the evidence proposed to be adduced at the requested hearing.

In addition to the comments and objections invited above, concerning the proposal and its environmental impact, OSHA hereby solicits comments from interested parties regarding the potential inflation impact of the proposed standard. Comments must be submitted in accordance with the above requirements for comments on the proposal and may be directed toward any or all of the following subjects:

1. Cost. impact on consumers, businesses and markets, or Federal, State, or local governments;

2. Effect on the productivity of wage earners, businesses, or government;

3. Effect on competition;

4. Effect on supplies of important materials, products, or services;

5. Effect on employment; and

6. Effect on energy supply or demand.

It is OSHA's intention to prepare an inflationary impact statement and analysis, if appropriate, or a certification that the standard has no substantial inflationary impact, and to make such statement or certification available at least 30 days prior to any public hearings on the proposed standard. The potential inflationary impact of the proposed standard would be an appropriate issue at such hearings.

This procedure has been concurred in by the Council on Wage and Price Stability in accordance with the Office of Management and Budget Circular A–107 (January 28, 1975), issued pursuant to Executive Order 11821 (39 FR 41501, November 27, 1974).

Accordingly, pursuant to sections 6(b) and 8(c) of the Occupational Safety and Health Act of 1970 (84 Stat. 1593, 1599; 29 U.S.C. 655, 657) and 29 CFR Part 1911, it is hereby proposed to amend Part 1910 of Title 29 of the Code of Federal Regulations as set forth below.

Signed in Washington, D.C., this 10th day of October, 1975.

John T. Dunlop,
Secretary of Labor.

§ 1910.1000 [Amended]

1. Table Z–2 in § 1910.1000 is proposed to be amended by deleting the entry for Trichloroethylene (Z37.19–1967).

* * * * *

2. A new § 1910.1027 is proposed to be added to Part 1910 of Title 29 of the Code of Federal Regulations, reading as follows:

§ 1910.1027 Trichloroethylene.

(a) *Scope and application.* This section applies to the production, release, packaging, repackaging, storage, transportation, handling, or use of trichloroethylene except that this section will not apply to working conditions with respect to which any other Federal agency has exercised statutory authority to prescribe or enforce standards or regulations affecting occupational safety or health hazards covered by this section.

(b) *Definitions.* "Director" means the Director, National Institute for Occupational Safety and Health, U.S. Department of Health, Education, and Welfare, or his designee.

"Emergency" means any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment which is likely to or does, result in the release of trichloroethylene in excess of the ceiling limit.

"Hazardous operation" means any procedure or activity where a release of the decomposition products of trichloroethylene such as chlorine, hydrogen chloride, phosgene and dichloroacetyl chloride might be expected as a consequence of the operation.

"Secretary" means the Secretary of Labor, or his designee.

(c) *Action level.* Action level means a concentration of trichloroethylene of 50 parts per million parts of air (50 ppm) as determined on an eight-hour time-weighted average, based on a 40-hour work week.

(d) *Exposure limits*—(1) *Permissible exposure limits*—(i) *Time-weighted average limit (TWA).* No employee may be exposed to an airborne concentration of trichloroethylene in excess of 100 parts per million parts of air (100 ppm), as determined on an eight-hour time-weighted average based on a 40-hour week; and

(ii) *Ceiling limit.* No employee may be exposed to an airborne concentration of trichloroethylene in excess of 150 parts per million parts of air (150 ppm) as averaged over any 15 minute period during the working day.

(2) *Dermal and eye exposure limit.* No employee may be exposed to eye contact or repeated skin contact with liquid trichloroethylene.

(e) *Determination and measurement of exposure*—(1) *Employee exposure.* For the purpose of this paragraph, employee exposure is that exposure which would occur if the employee were not using a respirator.

(2) *Determination of requirement for measurement.* Each employer who has a place of employment in which trichloroethylene is occupationally produced, released, packaged, repackaged, stored, transported, handled or used, shall inspect each workplace and work operation to determine if any employee may be exposed to airborne concentrations of trichloroethylene at or above the action level or in excess of the ceiling limit, or to eye contact or repeated skin contact with liquid trichloroethylene. Such a determination shall be based on the following, along with any other relevant considerations:

(i) Any information, observations, or calculations which would indicate employee exposure to trichloroethylene;

(ii) Any measurements which may have been taken of airborne concentrations of trichloroethylene; and

(iii) Any employee complaints of symptoms which may be attributable to exposure to trichloroethylene.

(3) *Negative determination.* When a determination is made that no employee is exposed to airborne concentrations of trichloroethylene at or above the action level or in excess of the ceiling limit, and that no employee is exposed to eye contact or repeated skin contact with liquid trichloroethylene, the employer shall make a record of such determination. This record shall include at least the information specified in paragraph (e)(2) of this section, and shall also include the date of the determination, the work being performed at the time, the location within the work site, and the names and the social security numbers of employees considered.

(4) *Positive determination.* When a determination conducted under paragraph (e)(2) of this section indicates the possibility of any employee exposure to airborne concentrations of trichloroethylene at or above the action level or in excess of the ceiling limit, the employer shall measure the exposure of the employee believed to have the greatest exposure in each work operation in which a positive determination is made. The exposure measurement shall be representative of the maximum exposure to the employee.

(5) If the exposure measurement taken pursuant to paragraph (e)(4) of this section reveals any employee exposure to airborne concentrations of trichloroethylene in excess of the action level or ceiling limit, the employer shall:

(i) Identify all employees who may be similarly exposed; and

(ii) Measure the exposures of the employees so identified.

(6) If exposure measurements taken pursuant to paragraph (e)(5) of this section reveal employee exposure at or above the action level, but below the permissible exposure limits, the employer shall repeat measurements for such employees at least every two months.

(7) If exposure measurements taken pursuant to paragraph (e)(5) of this section reveal employee exposure to be above the permissible exposure limits, the employer shall:

(i) Inform the employee in writing of the exposure as required by paragraph (e)(12) of this section;

(ii) Measure the exposure of the employee at least monthly; and

(iii) Institute control measures as required by paragraph (f) of this section.

(8) If two consecutive employee exposure measurements, taken at least one week apart, reveal that the employee is exposed to airborne concentrations of trichloroethylene below the action level and the ceiling limit, the employer may terminate monitoring for that employee.

(9) A record of all measurements shall be made and shall include at least the information required in paragraph (n)(2) of this section.

(10) Where a determination conducted under paragraph (e)(2) of this section shows that an employee may be exposed to eye contact or repeated skin contact with liquid trichloroethylene, the employer shall provide such employee with protective equipment and clothing in accordance with paragraph (h) of this section.

(11) *Redetermination.* Whenever there has been a production, process or control change which may result in new or additional exposures, or whenever the employer has any other reason to suspect a change in exposure conditions, a new determination under paragraph (e)(2) of this section shall be made.

(12) *Employee notification.* The employer shall individually notify in writing, within five working days after receipt of measurement results, every employee who is found to be exposed to trichloroethylene above the permissible exposure limits. Such notification need not be given more frequently than once per month. The employee shall also be notified of the corrective action being taken to reduce exposure to within permissible limits.

(13) *Method and accuracy of measurement.* (i) An employee's exposure shall be obtained by a combination of long-term or short-term samples which represent the employee's actual exposure as averaged over an 8 hour work shift (See Appendix B).

(ii) The method of measurement shall have an accuracy, to a confidence level of 95%, of not less than that given in Table 1 below.

TABLE 1

Concentration	Minimum Required Accuracy
At or below permissible exposure.	±35%
Above permissible exposure.	±25%

(Methods meeting these accuracy requirements are available from NIOSH.)

(f) *Methods of compliance.* Employee exposures to trichloroethylene shall be controlled to or below the permissible exposure limits provided in paragraph (d) of this section by engineering controls, work practices, and personal protection controls as follows:

(1) *Control priorities.* (i) Engineering controls shall be instituted immediately to reduce exposures to or below the permissible exposure limits, except to the extent that such controls are not feasible.

(ii) Wherever engineering controls which can be instituted immediately are not sufficient to reduce exposures to or below the permissible exposure limits, they shall nonetheless be used to reduce exposures to the lowest practicable level, and shall be supplemented by work practice controls.

(iii) Where engineering controls and supplemental work practice controls are insufficient to reduce exposures to or below the permissible exposure limits, they shall nonetheless be used to reduce exposures to the lowest practicable level, and shall be supplemented by the use of respirators in accordance with paragraph (f)(4) of this section.

(2) *Compliance program.* (i) A program shall be established and implemented to reduce exposures to or below the permissible exposure limits, or to the

greatest extent feasible, solely by means of engineering controls.

(ii) Written plans for such a program shall be developed and furnished upon request for examination and copying to the Secretary or the Director or both. Such plans shall be reviewed and revised at least every six months to reflect the current status of the program.

(3) *Mechanical ventilation.* When mechanical ventilation is used to control exposure, measurements which demonstrate the effectiveness of the system in controlling the exposure, such as capture velocity, duct velocity, or static pressure, shall be made at least every three months. Measurements of the system's effectiveness to control exposure shall also be made within five days of any change in production, process or control which might result in any change in airborne concentrations of trichloroethylene.

(4) *Respiratory protection*—(i) *Required use.* Respirators shall be used where required under this section. Compliance with the permissible exposure limits may not be achieved by the use of respirators except:

(*a*) During the time period necessary to institute engineering controls or work practice controls or both;

(*b*) In work operations in which engineering controls and supplemental work practice controls are not feasible;

(*c*) In work situations in which engineering controls and supplemental work practice controls are insufficient to reduce exposures to or below the permissible exposure limits; or

(*d*) In emergencies.

(ii) *Respirator selection.* (*a*) Where respirators are required under this section, the employer shall select and provide the appropriate respirator from Table 2 below and shall ensure that the employee uses the respirator provided.

(*b*) Respirators shall be selected from those approved by the Mining Enforcement and Safety Administration (formerly called the Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

TABLE 2: REQUIRED RESPIRATORY PROTECTION

Trichloroethylene concentration in air in part per million (ppm).	Equipment selection options (Respirators designated for higher concentrations of trichloroethylene may be used for any lower concentrations).
less than 1,000	(1) Chemical cartridge respirator with replaceable organic vapor cartridge(s) and half-mask facepiece (30 CFR 11.150); (2) A Type C supplied-air respirator, with one-half facepiece operated at a pressure demand mode. (30 CFR 11.110).
less than 5,000	(3) A supplied-air respirator, with a full facepiece operated at a pressure demand mode or continuous flow; (4) Gas mask, chin style with organic vapor canister and full facepiece.
greater than 5,000 and/or unknown.	(5) A supplied-air respirator, with a full facepiece operated at a pressure-demand mode or continuous flow; (6) Self-contained breathing apparatus, pressure demand type, with full facepiece (30 CFR 11.70(a)(2)(ii)).
firefighting	(7) A self-contained breathing apparatus with a full facepiece operated in pressure-demand (positive pressure) mode (30 CFR 11.70).

(iii) *Respirator program.* (*a*) The employer shall institute a respiratory protection program in accordance with § 1910.134 (b), (d), (e) and (f).

(*b*) Employees who wear respirators shall be allowed to leave work areas to wash their face and respirator facepiece to prevent potential skin irritation associated with respirator use.

(g) *Hazardous operations and emergency situations*—(1) *Hazardous operations.* (i) Any operation which generates or involves a high temperature source, open flame or ultraviolet light may not be performed in areas where airborne concentrations of trichloroethylene are present or may be present unless such operations are shielded and adequately ventilated. Examples of hazardous operations are those involving open flames, unshielded (unventilated) resistance heating, and arc welding or cutting.

(ii) Cleaning of or entry into tanks which have contained trichloroethylene shall be performed in accordance with § 1910.94 (d)(11)(ii), (iii), (iv) and (v).

(2) *Emergencies.* (i) A written plan for emergency situations shall be developed for each facility involved in a trichloroethylene operation in which there is a possibility of an emergency as defined in paragraph (b) of this section. Appropriate portions of the plan shall be implemented in the event of an emergency.

(ii) The plan shall specifically provide that employees engaged in correcting emergency conditions shall be equipped as required in paragraphs (f)(4) and (h) of this section until the emergency is abated.

(iii) Employees not engaged in correcting the emergency shall be restricted from the area and normal operations in the affected area shall not be resumed until the emergency is abated.

(h) *Protective equipment.* (1) Where splashes, sprays, spills, or eye or repeated skin contact with liquid trichloroethylene may ocur, employers shall provide and ensure that employees wear impermeable clothing, gloves, or coverings to protect the area of the body likely to come in contact with liquid trichloroethylene.

(2) Eye and face protection shall be provided in accordance with § 1910.133 (a)(2), (4), (5), and (6).

(i) *Housekeeping.* (1) Spills of trichloroethylene which could result in exposure in excess of the permissible exposure limits or which could expose employees to the risk of eye or repeated skin contact shall be cleaned up immediately by persons wearing appropriate respirators and protective equipment. Persons not wearing appropriate respiratory protection and protective equipment shall not be allowed in areas of the spills until cleanup has been completed or the concentration of trichloroethylene is within the permissible levels.

(2) The workplace shall be kept clean in accordance with § 1910.141(a)(3).

(3) Trichloroethylene waste shall be collected and disposed of in closed metal containers.

(j) *Sanitation.* (1) The employer shall provide adequate washing facilities in accordance with § 1910.141(d).

(2) The employer shall provide eye wash facilities which are immediately accessible to each operation and are suitable for quick drenching or flushing of the eyes for emergency use where trichloroethylene is used.

(k) *Employee information and training*—(1) *Training program.* (i) The employer shall provide a training program for employees assigned to workplace areas in which trichloroethylene is produced, released, packaged, repackaged, stored, handled or used.

(ii) The training program shall be provided at the time of initial assignment, and at least annually thereafter, and shall include informing each employee of:

(*a*) The information contained in the substance data sheets for trichloroethylene, which are contained in Appendixes A and B of this section;

(*b*) The quantity, location, manner of use, release or storage of trichloroethylene and the specific nature of operations which could result in exposure at or above the action level or ceiling limit as well as necessary protective steps;

(*c*) The purpose, proper use, and limitations of respiratory devices as specified in § 1910.134;

(*d*) The purpose and a description of the medical surveillance program required by paragraph (m) of this section and the information contained in Appendix C of this section;

(*e*) Emergency procedures required by paragraph (g)(2) of this section; and

(*f*) The contents of this standard.

(2) *Access to training materials.* (i) A copy of this standard and its appendixes shall be made readily available to all employees exposed to trichloroethylene.

(ii) The employer shall, upon request, provide the Secretary or the Director all materials relating to the employee information and training program.

(l) *Signs and labels.* (1) *General.* (i) Signs or labels required by this paragraph may be in addition to or in combination with signs or labels required by other statutes, regulations or ordinances.

(ii) No statement shall appear on or near any required sign, label or instruction which contradicts or detracts from the message of any such required sign, label or instruction.

(2) *Signs.* (i) All entrances or access ways to areas where trichloroethylene is present to the extent that an employee may be exposed in excess of the action level shall be marked with legible signs bearing at least the following information:

CAUTION (or WARNING)
TRICHLOROETHYLENE
AVOID SKIN CONTACT AND INHALATION OF VAPOR

(ii) In addition to the signs required by paragraph (l)(2)(i), all areas where concentrations of trichloroethylene exceed the TWA or ceiling shall be posted with legible signs bearing at least the following information:

CAUTION (or WARNING)
TRICHLOROETHYLENE VAPORS
USE RESPIRATORS IN THIS AREA

(3) *Labels.* Precautionary labels shall be applied to all containers, packages or equipment containing trichloroethylene. The label shall provide at least the following information:

(i) The word "CAUTION" or "WARNING,"

(ii) The word "TRICHLOROETHYLENE," and

(iii) A warning statement against breathing vapors or having skin or eye contact with liquid trichloroethylene.

(m) *Medical surveillance*—(1) *General requirements.* (i) For the purposes of this paragraph, employee exposure is that exposure which would occur if the employee were not using a respirator.

(ii) Each employer shall institute a medical surveillance program for all employees who are or will be exposed to concentrations of trichloroethylene at or above the action level or in excess of the ceiling level.

(iii) The program shall provide each affected employee with an opportunity for medical examinations in accordance with this paragraph.

(iv) All medical examinations and procedures shall be performed by or under the supervision of a licensed physician, and shall be provided during the employee's normal working hours, without cost to the employee.

(v) If any employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and shall obtain a signed statement from the employee indicating that the employee understands the risk involved in the refusal to be examined.

(2) *Preplacement examinations.* At the time of initial assignment, or upon institution of medical surveillance, the following shall be performed by the physician:

(i) A medical history, which shall cover at least:

(*a*) Cardiac problems and pulmonary diseases;

(*b*) Seizure disorders;

(*c*) Liver disease;

(*d*) Incidence of headache, nausea, and dizziness;

(*e*) Eye complaints;

(*f*) Irritation of mucous membranes;

(*g*) Skin irritations;

(ii) A complete work history; and

(iii) A medical examination which must include at least the following:

(*a*) A general physical examination;

(*b*) Electrocardiogram (EKG);

(*c*) Urinalysis;

(*d*) Pulmonary function test; and

(*e*) Complete blood count.

(3) *Periodic examinations.* Examinations and medical and work histories specified in paragraph (m)(2) of this section shall be provided at least annually for all employees specified in paragraph (m)(1) of this section.

(4) *Interim examinations.* (i) Each employee exposed to trichloroethylene due to the occurrence of an emergency shall be provided the medical examinations prescribed in paragraph (m)(2) of this section.

(ii) If the employee is accidentally or otherwise exposed by ingestion, inhalation or by skin or eye contact under conditions known or suspected to be hazardous or for any reason develops signs and symptoms commonly associated with toxic exposure to trichloroethylene, the employer shall provide appropriate emergency medical treatment.

(5) *Alternative medical examinations.* If the examining physician determines that medical examinations alternative to those specified in paragraph (m)(2) of this section will provide at least equal assurance of detecting medical conditions pertinent to protecting the employee against overexposure to trichloroethylene, the employer may accept such alternative medical surveillance examinations and tests as meeting the requirements of paragraph (m)(2) of this section, provided that the employer:

(i) Obtains a statement from the examining physician setting forth the alternative medical examinations or tests and the rationale for their substitution and submits such statement to the Secretary; and

(ii) Informs each exposed employee of the fact that medical examinations or tests alternative to those required in paragraph (m)(2) of this section are to be made available.

(6) *Information provided to the physician.* The employer shall provide the following information to the examining physician:

(i) A copy of this regulation for trichloroethylene including Appendixes A, B, and C;

(ii) A description of the affected employee's duties as they relate to exposure to trichloroethylene;

(iii) A description of any personal protective equipment used;

(iv) The results of the employee's exposure measurements, if available;

(v) The employee's anticipated exposure level; and

(vi) Upon request of the physician, information from previous medical examinations of the affected employee.

(7) *Physician's written opinion.* (i) The employer shall obtain, and furnish the employee with a copy of, a written opinion from the examining physician containing the following:

(*a*) Signs and symptoms of toxic effects of trichloroethylene manifested by the employee, if any;

(*b*) The physician's opinion as to whether the employee has any detected medical condition which would place the employee at increased risk of material impairment to the employee's health from exposure to trichloroethylene, or would directly or indirectly aggravate any detected medical condition;

(*c*) Any recommended limitations upon the employee's exposure to trichloroethylene or upon the use of protective equipment and respirators; and

(*d*) A statement that the employee has been informed by the physician of any medical conditions which require further examination or treatment.

(ii) The written opinion obtained by the employer may not reveal specific findings or diagnoses unrelated to occupational exposure to trichloroethylene.

(iii) If the employer determines, on the basis of the physician's written opinion, that any employee's health would be materially impaired by maintaining the existing exposure to trichloroethylene, the employer shall place specific limitations, based on the physician's written opinion, on the employee's continued exposure to trichloroethylene. In no case shall any employee be placed at increased risk of material impairment of health from such exposure.

(n) *Recordkeeping.*—(1) *Exposure determinations.* The employer shall keep an accurate record of all determinations required by paragraphs (e)(2) and (e)(3) of this section.

(i) This record shall include the written determination and any supporting documentation required by paragraphs (e)(2) and (e)(3) of this section.

(ii) This record shall be maintained for at least two years or until replaced by a more recent determination, whichever is longer.

(2) *Measurements.* The employer shall keep an accurate record of all measurements taken to monitor employee exposure to trichloroethylene.

(i) This record shall include:

(*a*) The date of measurements;

(*b*) The operation involving exposure to trichloroethylene which is being monitored;

(*c*) Sampling and analytical methods used and evidence of their accuracy;

(*d*) Number, duration, and results of samples taken;

(*e*) Type of protective devices worn, if any; and

(f) Name and social security number and exposure levels of the employee monitored.

(ii) This record shall be maintained for at least ten years.

(3) *Mechanical ventilation measurements.* When mechanical ventilation is used as an engineering control, the employer shall maintain a record of the measurements demonstrating the effectiveness of such ventilation as required by paragraph (f)(3) of this section.

(i) This record shall include:

(a) Date of measurement;

(b) Type of measurement taken; and

(c) Result of measurement.

(ii) This record shall be maintained for at least two years.

(4) *Employee training.* The employer shall keep an accurate record of all employee training required by paragraph (k) of this section.

(i) This record shall include:

(a) Date of training;

(b) Name and social security number of employee trained; and

(c) Content or scope of training provided.

(ii) This record shall be maintained for at least one year.

(5) *Medical surveillance.* The employer shall keep an accurate medical record for each employee subject to the medical surveillance program required by paragraph (m) of this section.

(i) The record shall include:

(a) The physician's written opinion;

(b) Any employee medical complaints related to exposure to trichloroethylene;

(c) A copy of the information provided to the physician as required by paragraph (m)(6) of this section; and

(d) A signed statement of any refusal to be examined.

(ii) This record shall be maintained for at least ten years.

(6) *Availability.* (i) Employers shall, upon request, make available to the Secretary or Director for examination and copying all records required to be maintained by this section.

(ii) Written determinations and employee exposure measurements records required by paragraphs (n)(1) and (n)(2) of this section shall be made available for examination and copying upon request of employees, former employees, or their designated representatives.

(iii) Employee medical records required to be maintained by this section shall be made available for examination and copying upon request of a physician designated by the affected employee or former employee.

(7) *Transfer of records.* (i) In the event the employer ceases to do business, the successor employer shall receive and retain all records required to be maintained by this section.

(ii) In the event the employer ceases to do business and there is no successor to receive and retain the records, these records shall be transmitted by registered mail to the Director, and each employee and former employee shall be individually notified in writing of this transfer.

(o) *Observation of monitoring*—(1) *Employee observation.* The employer shall give his employees or their representatives an opportunity to observe any measuring of their exposure to trichloroethylene which is conducted pursuant to this section.

(2) *Observation procedures.* (i) When observation of the monitoring of employee exposure to trichloroethylene requires entry into an area where the use of personal protective equipment is required, the observer shall be provided with and required to use such equipment and shall comply with all other applicable safety procedures.

(ii) Without interfering with the measurement, observers shall be entitled to:

(a) Receive an explanation of the measurement procedures;

(b) Observe all steps related to the measurement of airborne concentrations of trichloroethylene performed at the place of exposure; and

(c) Record the results obtained.

(p) *Effective date.* This standard shall become effective 30 days following publication of the final standard in the FEDERAL REGISTER.

(q) *Startup dates*—(1) *Determination and measurement.* Determinations and measurements prescribed in paragraph (e) of this section shall be instituted within three months of the effective date of the final standard, except that for new production areas or operations begun after the effective date, such determinations and measurements shall be instituted within 30 days of startup of operation.

(2) *Medical surveillance.* Medical surveillance prescribed in paragraph (m) of this section shall be instituted within three months of the effective date of the final standard.

(r) *Appendixes.* The information contained in the following appendixes of this section is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or to detract from any existing obligation.

APPENDIX A—SUBSTANCE SAFETY DATA SHEET TRICHLOROETHYLENE

I. Substance Identification

A. *Substance:* Trichloroethylene.

B. *Permissible exposure:*

1. *Airborne.* One hundred (100) parts of trichloroethylene vapor per million parts of air (100 ppm), time-weighted average (TWA) for an eight-hour workday, with a ceiling limit of 150 ppm.

2. *Dermal.* No employee may be exposed to any eye or repeated skin contact with tricholoroethylene.

C. *Appearance and odor:* Trichloroethylene is clear, colorless liquid with a "sweet" odor. You can generally smell trichloroethylene at levels lower than the permissible exposure limits.

II. Health Hazard Data

A. *Ways in which trichloroethylene affects your body:* Trichloroethylene can affect your body if you inhale it, swallow it, or if it comes in contact with your eyes or skin.

B. *Effects of overexposure:*

1. *Short-term overexposure.* If you are overexposed to trichloroethylene, your eyes may become irritated and your throat may feel dry. Trichloroethylene splashed in the eyes is very painful. You may have a feeling of lightheadedness or "drunkenness," and also have a headache, feel dizzy, nauseous, sleepy, and fatigued. Trichloroethylene can produce unconsciousness rapidly, and death may result.

2. *Long-term (chronic) overexposure.* Repeated and prolonged overexposure can cause reddening and irritation of the skin, possible damage to the nervous system, liver damage, lightheadedness, and dizziness.

III. Reporting Symptoms

You should inform your employer if you develop any of the above symptoms and suspect that they may be caused by exposure to trichloroethylene.

IV. Emergency and First Aid Procedures

A. *Breathing.* If you breathe in large amounts of trichloroethylene or if you develop any of the symptoms listed above, leave the contaminated area and get to fresh air immediately. Artificial respiration should be applied if breathing has stopped. Call a doctor as soon as possible.

B. *Eye or face exposure:* If trichloroethylene is splashed in your eye, wash it out immediately with large amounts of water. Remove contact lenses at the same time. Wash the face immediately if splashed by trichloroethylene. Call a doctor as soon as possible.

V. Protective Equipment and Clothing

A. *Respirators:* Suitable respirators are to be worn:

(1) During the time period necessary to install engineering controls to reduce the airborne concentration of trichloroethylene below 100 ppm.

(2) In work situations in which engineering controls are not feasible to reduce the airborne concentration of trichloroethylene below the permissible exposure limits; or

(3) In emergencies. Where new respirators are worn, they must have a NIOSH label of approval. Older respirators which have a Mining Enforcement and Safety Administration (MESA) or Bureau or Mines (BM) approved label may be used. If you experience difficulty in breathing while wearing a respirator, tell your employer.

VI. Precautions for Safe Use, Handling and Storage

Trichloroethylene should be stored in a cool, dry, and well ventilated area. Operations producing a high temperature and ultraviolet light, such as open flames, unshielded resistance heating, arc welding, etc., may not be done where trichloroethylene vapors are present. Your supervisor must tell you where trichloroethylene is used in your area and what additional plant safety procedures are used.

APPENDIX B—SUBSTANCES TECHNICAL GUIDELINES TRICHLOROETHYLENE

I. Physical and Chemical Data

A. *Substance identification:*

1. *Synonyms:* Trichloroethylene, TCE

2. Formula: $ClCH=CCl_2$

B. *Physical data:*

1. Boiling Point (760 mm Hg): 87.1 C (188.7°F).

2. Specific Gravity at 20/4 C (68/39 F). (Water —1): 1.464.

3. Vapor Density (air=1.0): 4.5.

4. Melting Point: —73 C (—99.4°F).

5. Vapor Pressure at 25 C: 74.3 mm Hg.

6. Solubility in Water at 25 C: 0.1 part.

7. Appearance and Odor: Colorless liquid, sweet odor.

II. Fire, Explosion and Reactivity Hazard Data

A. *Fire:*

1. Auto Ignition Temperature: 463.0°C.

2. Flammable Limits in Air, % by Volume: Lower Upper 41% at 100°C. "Trichloroethylene does not form flammable mixtures with air at ordinary temperature and pressure."

B. *Reactivity:*

1. *Conditions contributing to instability:* Light, water vapor, ultraviolet radiation, open flames.

2. *Incompatibility:* Strong alkalis and certain metals.

3. *Hazardous decomposition products:* Phosgene, hydrogen chloride, dichloroacetylene.

III. Spill and Leak Procedures

A. *Steps to be taken if the material is released or spilled:* Respirators should be available nearby for possible evacuation and for clean-up. Flush floors with water, not into a confined place such as a sewer.

B. All employees engaged in clean-up operations shall wear protective clothing and equipment.

(c) *Waste disposal method:* Trichloroethylene-contaminated waste should be stored in a ventilated area in closed metal drums, and disposed of in properly designated incinerators.

IV. Addiction to Trichloroethylene

Addicts can show mental changes in such things as irritability, changes in personality, increased dreaminess, and decreases in coordination. They also experience tremors, nausea, and mild delirium.

V. Monitoring and Measurement Procedures

A. *Monitoring program below permissible limits:* Measurements taken for the purpose of determining employee exposure under this section are best taken in such a fashion that the average eight-hour exposure may be determined from a single eight-hour or two four-hour samples. Short time interval samples (up to 30 minutes) may also be used to determine average exposure level if a minimum five measurements are taken in a random manner over the eight-hour work shift. Random sampling means that any portion of the work shift has the same chance of being sampled as any other. The arithmetic average of all such random samples taken in one work shift is an estimate of an employee's average level of exposure for the work shift. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analysis may be performed by instruments, such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, gas and vapor absorption tubes with subsequent chemical analysis dosimeters or with continuous monitoring systems that can sample and analyze those areas that would accurately represent the highest airborne concentrations of trichloroethylene where employees are exposed. The analytical method must determine the concentrations of trichloroethylene to plus or minus 35%.

B. *Monitoring program above permissible limit:* The monitoring under this section should be essentially the same as described above, except that portable direct-reading instruments should be NIOSH certified and should receive regular maintenance and calibration. Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association (AIHA). The analytical method must determine the concentrations of trichloroethylene to plus or minus 25%.

APPENDIX C—MEDICAL SURVEILLANCE GUIDELINES

I. Route of Entry

Primarily inhalation; also ingestion and skin and eye contact.

II. Toxicology

This substance, trichloroethylene, is a central nervous system depressant. It can also cause cardiac arrhythmia, and with high enough levels—renal and hepatic impairment. Skin tests on human subjects caused irritation only when trapped against the skin. Reports have been made of loss of smell, sight, and and intolerance to alcohol.

III. Signs and Symptoms

Headache, nausea, dizziness, uncoordination, mental confusion, fatigue, irritation of eyes and skin, and irritation of respiratory tract.

IV. Special Tests

None in common usage.

V. Treatment

Remove from exposure. Flush eyes and skin with water. If swallowed; do not make person vomit.

VI. Surveillance and Preventive Considerations

A. *Preplacement:* A routine medical examination and a complete medical and work history are required to be made available. Those employees giving a positive history on these conditions (listed below) should not be placed where there is increased risk from trichloroethylene.

1. *Skin disease.* Trichloroethylene can cause dermatitis on prolonged exposure. Persons with preexisting skin disorders may be more susceptible to the effects of this agent.

2. *Liver and kidney disease.* There have been reported cases of liver impairment due to inhalation of trichloroethylene. Although this is not common, because trichloroethylene is a chlorinated solvent, people with liver disease should not be placed in an area of possible exposure.

3. *Heart disease.* Trichloroethylene has caused arrhythmias, fibrillation, and extrasystoles; therefore, persons who have a heart condition should not be placed in areas of exposure.

4. *Alcoholics.* People are much more intolerant to alcohol when they have been exposed to trichloroethylene.

5. *Exceedingly fleshy or undernourished individuals.* These people are unduly susceptible to various chlorinated hydrocarbons.

6. *Those suffering from paralysis, convulsive seizures, and highly nervous states.* As trichloroethylene is a central nervous system depressant, people with these types of problems should not be exposed to high levels of this solvent.

C. *Periodic examinations:* Annual physical examinations are required to be made available. These should include as a minimum a urinalysis, CBC, a pulmonary function test, and an electrocardiogram.

REFERENCES.—1. Chemical Safety Data Sheet: Trichloroethylene, Revised 1956, MCA. 2. Patty, Frank A., *Ind. Hyg. and Tox.*, Vol. II, pp 1309–1313, 1963.

(Secs. 4, 6, 8, 84 Stat. 1592, 1593, 1599 (29 U.S.C. 653, 655, 657) and 29 CFR Part 1911)

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